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APPLICATION OF SOME STATISTICAL PARAMETERS TO THE QUATERNARY DEPOSITS OF BOS A

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ABSTRACT. - Supplementary to the former investigations of the Quaternary deposits of Bos van A some statistical parameters were used in order to analyse their environmental meaning.
The parameters include the graphic mean (M_z), the inclusive graphic standard deviation (σ_i), the inclusive graphic skewness (SK_i), the fine and coarse- grained tail fractions.
By means of scatter plots a clear distinction between the fluviatile channel deposits and the eolian deposits is shown, on the contrary the differentiation between the eolian - and the floodplain deposits is limited.
Due to the use of certain parameters in relation with stratification a better understanding of the previous existing environments is obtained.

INTRODUCTION.

During the activities in the sandpit of Bos van A in Zemst, not only profiles were made (F. BOGEMANS, 1983) but a large amount of samples were taken, on which more specific research has been executed afterwards. In a first phase granulometrical analyses were carried out, because the particle size distribution is considered as an indicator of environment. The grain size distribution is determ by the availibility of the particles of a different diameter and the operative processes in the depositional area.

Bos van A is situated sedimentologically-climatologically in the transitional area (R. PAEPE, 1967). Pedologically the greatest part of this unity coincides with the sandloam region of Belgium.

The profiles of Bos van A are characterized by an extensive fluviatile packet (concist of channel- and floodplain deposits), bound by a small eolian cover. Although the scanty extension, the eolian packet can be divided into different lithological units.

PROCEDURE.

One hundred analyses were carried out, of which only a small number will be presented in this paper.

The samples that will be discussed further on, are chosen in a way so as to represent a whole sequence of Quaternary deposits, with exception of the basic deposits, and this over a comparative small distance (fig. A). The granulometrical analysis were done by using pipette and dry-sieving methods. The sieve meshopenings increase with the ratio of $\sqrt{2}$ or 1/2 ϕ.

From the sustained particle-size distribution of each sample the parameters of position (mean), of deviation (standard deviation) and of shape (skewness) were calculated.

These parameters are defined graphically by using the phivalues of the percentiles, which have been read from the log-probability curves.

The gathered values are put in the following formulae of FOLK and WARD (1957).

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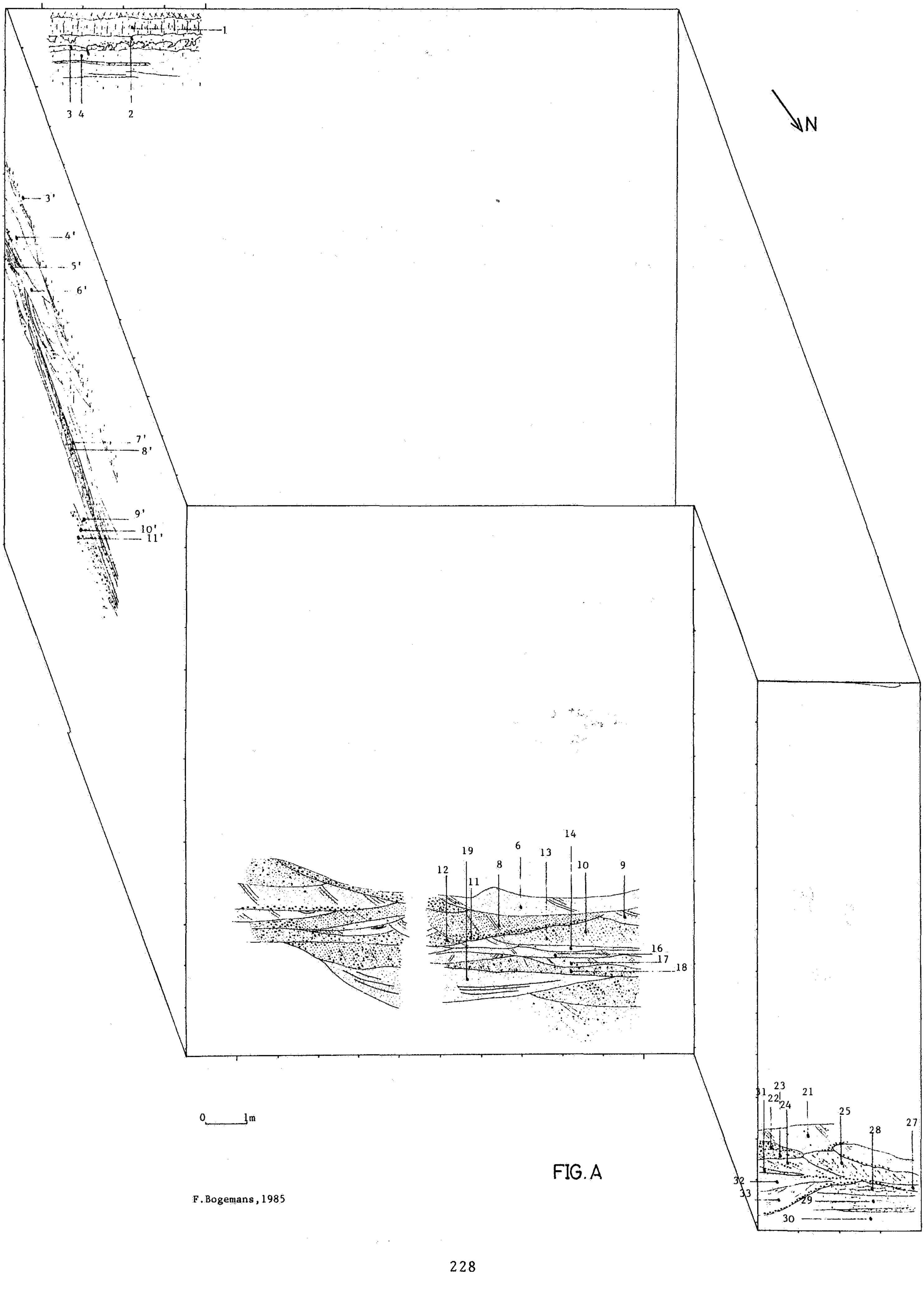

FIG. A

F.Bogemans,1985

Graphic mean :

$$M_z = \frac{\phi16 + \phi50 + \phi84}{3}$$

Inclusive graphic standard deviation :

$$\gamma_i = \frac{\phi84 - \phi16}{4} + \frac{\phi95 - \phi5}{6,6}$$

Inclusive graphic skewness

$$Sk_i = \frac{\phi84 + \phi16 - \phi50}{2\ (\phi84 - \phi16)} + \frac{\phi95 + \phi5 - \phi50}{2\ (\phi95 - \phi5)}$$

A part from the statistical parameters, the values of the fine and the coarse tails were also used in our research.

RESULTS.

The study of the size-frequency distributions had a double purpose, in the first place to analyse the distinction and/or overlapping of the eolian and fluviatile deposits and in a second phase to make a possible subdivision of the sediments.

For this purpose scatter plots were used, since they allow a quantitative comparison between the different parameters.

A. DESCRIPTION OF THE FIGURES.

In figure I the graphic mean (M_z) is plotted against the inclusive standard deviation. A clear separation between the eolian and fluviatile sediments is visible.

The eolian deposits have a mean value higher than 4Ø and a standard deviation greater than 2. The high value of the latter stands for a bad sorting (classification after FOLK and WARD). This bad sorting degree and the high phi-value is the result of a considerable percentage of clay.

The fluviatile sediments have a mean value below 3Ø, with exception of three samples. The samples have an increasing phivalue, but differ in various ways from the eolian.

The standard deviation is characterized by strong fluctuations (values between 0.39 and more than 2.6).

By using this parameter the fluviatile sediments are split up into three groups :

value smaller than 1 (well to moderately sorted);
between 1 and 2 (poorly sorted);
greater than 2 (very poorly sorted).

The well to moderately sorted sediments possess a mean value between 1 and 3Ø, the very poorly sorted deposits normally have a value below 0Ø.

Figure II represents the graphic mean versus the inclusive graphic skewness and shows again a clear separation between the eolian and fluviatile sediments.

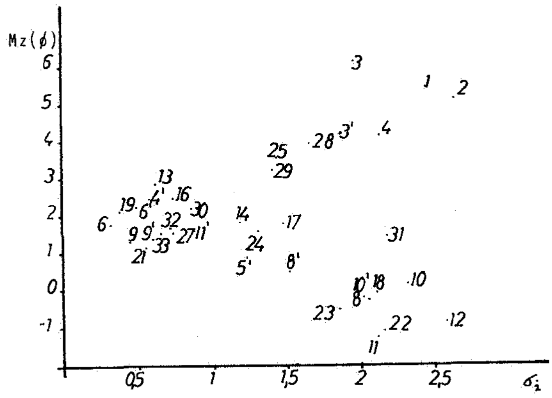

FIG. I

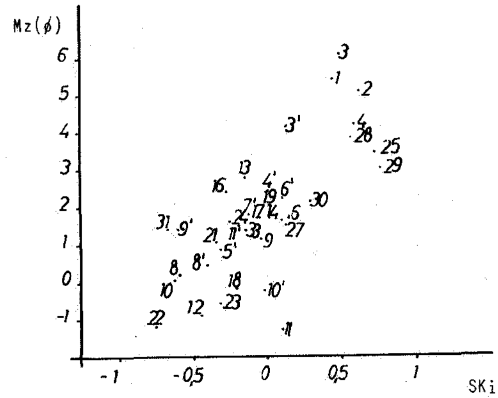

FIG. II

Figure II represents the graphic mean versus the inclusive graphic skewness and shows again a clear separation between the eolian and fluviatile sediments.

The eolian facies and the above mentioned three samples have a skewness greater than + 0.46, which means that these deposits have an extremely positive asymmetry.

The coarse fractions have on the whole a negative and extremely negative asymmetry (values smaller than 0.1). In these sediments the skewness is very close to a function of grainsize. By addition of coarse fractions to the sediment, the skewness will become negative. This negative asymmetry will grow till a certain amount of gravel (ex. sample n° 11) is exceeded, than the trend will reverse and become almost symmetrical.

In figure III the skewness is plotted against the standarddeviation. This scatter plot shows on the one side a separation of the eolian and the fluviatile deposits (except the three samples). On the other hand the fluviatile sediments are subdivided. The well to moderately sorted samples have a positive to negative asymmetry, the poorly to very poorly sorted

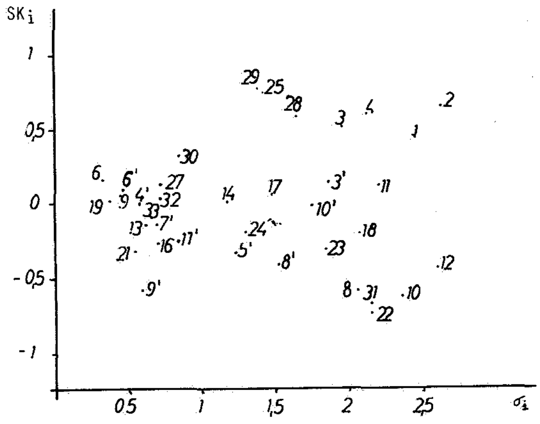

FIG. II

have a negative up to extremely negative skewness.

In the next figure (IV) the first percentile is plotted against the fraction smaller than 53u. The samples with a first percentile value above 1.5Ø have a silt- and clayfraction above 10 %. If the percentile-values are plotted below 1.5Ø, the quantity of silt and clay is diminished to less than 5 %. The fluviatile deposits correspond grosso modo with the last mentioned values.

These parameters are also useful to represent the separation between the eolian and fluviatile sediments.

Figure V is the representation of the standard deviation against the fractions larger than 1,7 mm.

The very poorly sorted sediments are divided into two groups; the first group possess no particles larger than 1.7 mm, the other group contains minimally 15 % of coarse material. The first encloses the eolian sediments, the second a certain part of the fluviatile. The other fluviatile sediments are split up again into two groups : the poorly sorted deposits are built up by a coarse fraction that fluctuate between zero and twenty percent. The good to moderately sorted sediments have always a value below five percent.

B. DISCUSSION.

The scatter plots that have been used, show a clear distinction between the eolian and the fluviatile sediments, more specifically the channel deposits.

On the contrary, the floodplain deposits (n° 25, 28, 29) are plotted in the neighbourhood of the eolian sediments, but with certain differentiations. The eolian sediments have a graphic mean above 4Ø, caused by the silt and clay portion. Because these sediments are composed of several subpopulations, the sorting degree is very bad. The skewness fluctuates around +0.5 (extremely positive asymmetry), which indicates that the grain-size distribution of the beds have a tail of fines.

The floodplain deposits have a graphic mean between 4 and 3Ø and a bad sorting, although the classification is better, due to the dominance of one subpopulation. The positive skewness has a higher value than the one of the wind deposits, because the tails have a larger portion in the particle-size distribution.

Two of the three alluvial beds consist of climbing ripple lamination type A (A. V. JOPLING & R. G. WALKER, 1968). The angles of the ripples of type A are determined by the current velocity (G. M. ASHLEY, J. B. SOUTHARD & J. C. BOOTHROYD, 1982). The bed where sampling 29 was carried out, has ripples with smaller angles than the overhead layer with sample 25.

It may be assumed the the stream velocity influences the texture but not the sortingdegree, because the sorting is identical in both layers. When the velocity is decreasing steadily and enough sediments are available, ripples of type B and C are usually formed (bed with sample 28). The decreasing stream velocity is also recognized in the texture of the above mentioned layer.

Consequently the bad sorting has to be ascribed to the fast sedimentation through which ripples are covered.

The channel deposits are defined by a graphic mean smaller than 3Ø and a strong fluctuating standard deviation and skewness.

The small amount of deposits with a mean between 1 and 0Ø is the result of a sudden change in the sedimentation rate (see fig. 20.8 A. J. PANNEKOEK, 1982).

According to the profiles, the sorting degree improves when the texture of the sediments decreases, with a moderate to good classification of the fine and medium sands. The better sorting can be explained by selective entrainment, in which only the fraction of the material smaller then the threshold is transported (D. KNIGHTON, 1984).

The better erodibility and movability of the fine and medium sands may also provide the better sorting degree.

In the group consisting of poorly to extremely poor sorted sediments a slight amelioration is observed when the foresets were formed due to avalanching, because only then a certain amount of particles is settles (H. E. REINECK & I. B. SINGH, 1980).

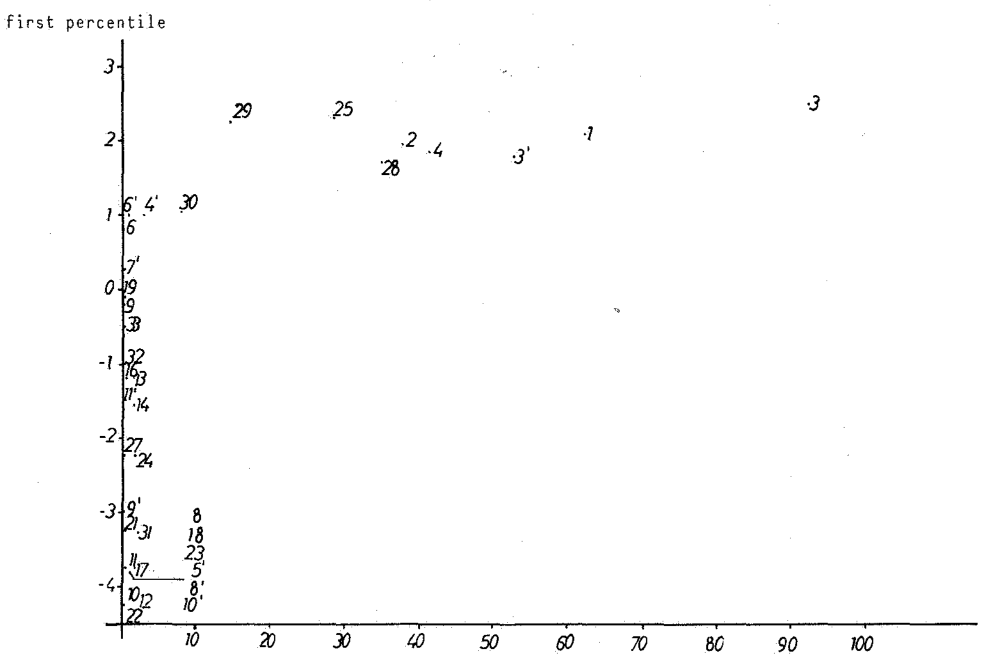

FIG. IV

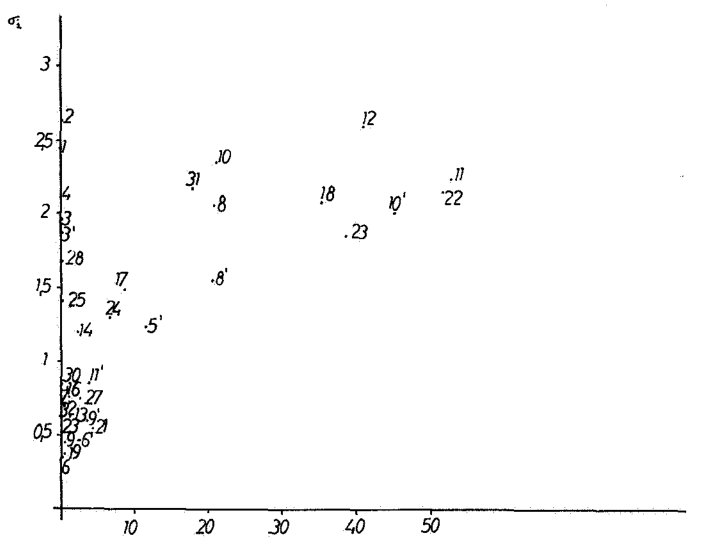

FIG. V

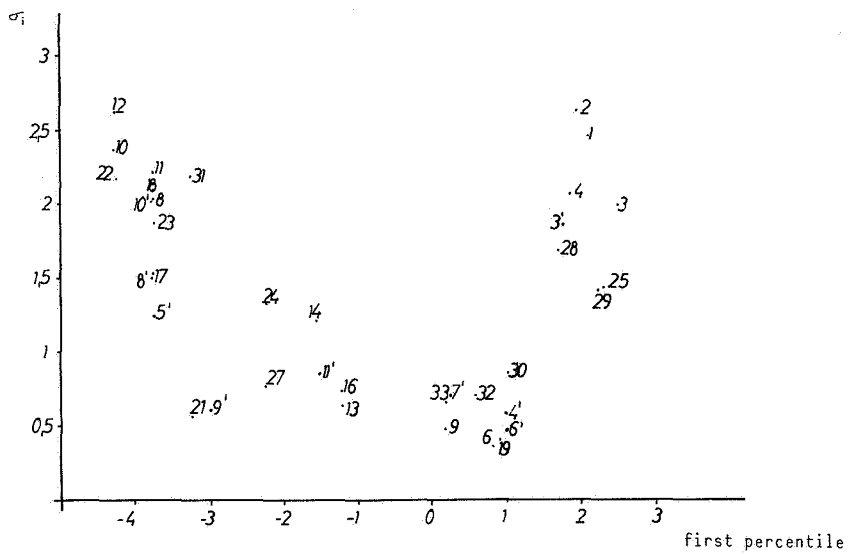

FIG. VI

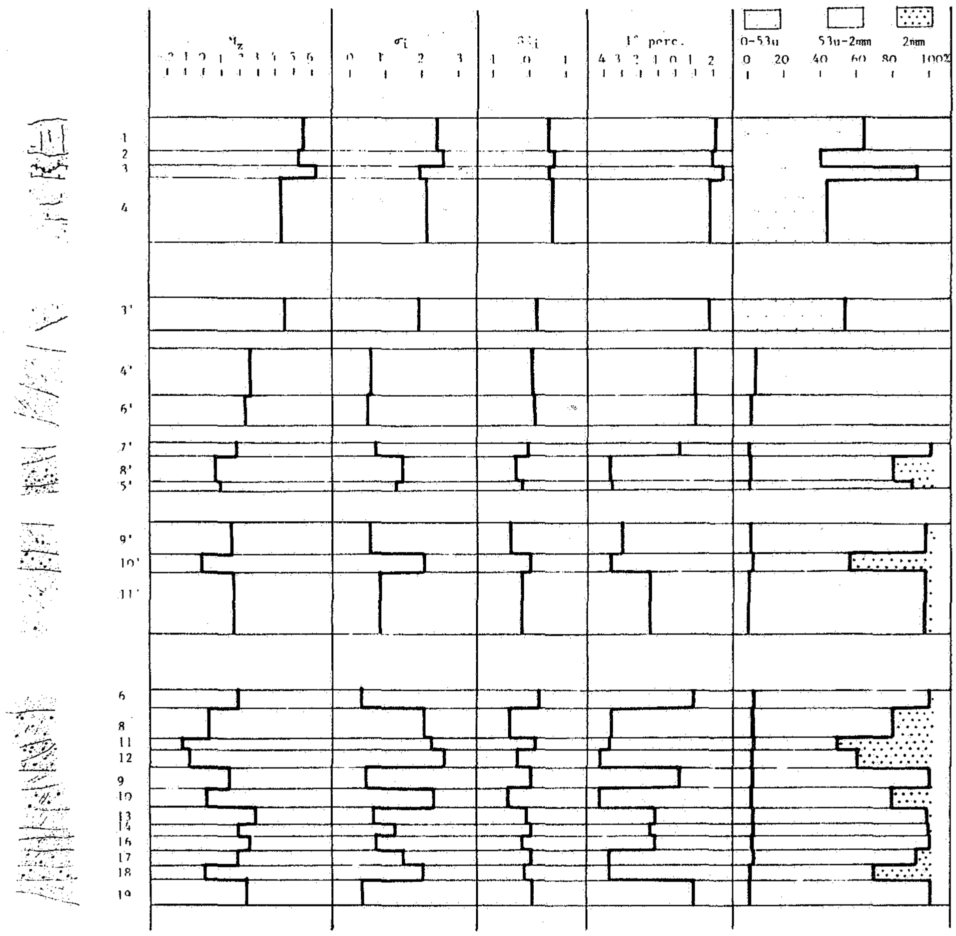

FIG. B

C. APPLICATION OF SOME PARAMETERS.

Figure B represents a vertical sequence, based on the samples discussed above, of the Quaternary deposits, except for the basic sediments.

These basic sediments belong chronostratigraphically to the Eemian and Early Weichselian Age (BOGEMANS & J. P. CASPAR, 1984).

The fluviatile sediments are built up by several cycles. One cycle is characterized by a fining up of the sediments and it is the result of a change of the water discharge.

When the mean size per cycle is calculated, in the basic part of the sequence the phi value of the mean decreases towards the top. The coarser texture is the result of a smaller magnitude of a cycle. This fact illustrates a decrease in fluviatile activity.

Although the sediments in the second part are becoming finer near the top, the cause is identical; namely a further decrease of the fluviatile activity. This part is comparable to the one R. PAEPE described in 1972.

Based on our field observations it appears that the skewness in this area is a vital clue to indicate several depositional environments.

Particulary in this place three environments, with local variations can be recognized.

Till sample n° 7' the skewness of the fluviatile deposits fluctuates in a fixed pattern from a negative to a value of almost zero.

The other fluviatile samples were collected in deeper channels and they have a symmetrical skewness. This type of channel points out a more concentrated course and a constant flow over a longer period, so that a better sorting is obtained.

The eolian sediments are defined by a positive skewness.

Lithostratigraphically, these deposits start with sediments characterized by slightly fluvial activities (samples n° 4 & 3'). The humic phase turns into a dryer, that results in a very silty deposits, called coverloam 1 after R. PAEPE (1967) (sample n° 3), followed by a sandy cryoturbed layer, called coversand 2 (sample n° 2). The sequence is delimitated by the late coversands (sample n° 1), of which the texture is more silty, like R. PAEPE had already mentioned in 1967.

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